

Analgesic efficacy of peritubal infiltration of ropivacaine versus ropivacaine and morphine in percutaneous nephrolithotomy under ultrasonic guidance

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ABSTRACT

Background and Purpose: Percutaneous nephrolithotomy is a safe and effective endourologic procedure which is less morbid than open surgery. However, pain around a nephrostomy tube requires good post-operative analgesia. We hypothesize that infiltration of local anesthetic with opioid from the renal capsule to the skin around the nephrostomy tract under ultrasonic guidance would alleviate the postoperative pain for a long period. **Methods:** A total of 60 ASA physical status I to II patients were selected for a prospective randomized double-blind controlled study in percutaneous nephrolithotomy surgeries. Patients were divided into group R ($n=30$) and group RM ($n=30$). Balanced general anesthesia was given. After completion of the surgical procedure, a 23-gauge spinal needle was inserted at 6 and 12 O'clock position under ultrasonic guidance up to renal capsule along the nephrostomy tube. A 10 ml drug solution was infiltrated in each tract while withdrawing from renal capsule to the skin. After extubation, the patient was shifted to the post-anesthesia care unit for 24 hours. Post-operative pain was assessed using the visual analog scale (VAS) and dynamic visual analog scale (DVAS) (during deep breathing and coughing) rating 0-10 for initial 24 hours. Rescue analgesia was given in the form of injection tramadol 1.0 mg/kg intravenously when $VAS \geq 4$ and maximum up to 400 mg in 24 hours. Time to 1st rescue analgesic, number of doses of tramadol and total consumption of tramadol required in initial 24 hours were noted. Patients were observed for any side effect and treated accordingly. **Results:** Time to 1st rescue analgesic, i.e., duration of analgesia in group RM is more prolonged than group R ($P=0.0004$). The number of doses of tramadol in 24 hours in group R were higher as compared to group RM ($P=0.0003$). The total amount of tramadol in 24 hours in group R was more than in group RM ($P=0.0013$). Side effects like nausea and vomiting and sedation were comparable in both the groups. **Conclusion:** Addition of morphine to ropivacaine for nephrostomy tract infiltration significantly prolonged the duration of post-operative analgesia and reduced the number of doses and total consumption of rescue analgesic in initial 24 hours in percutaneous nephrolithotomy surgery.

Key words: Morphine, percutaneous nephrolithotomy, ropivacaine, ultrasound

INTRODUCTION

Percutaneous nephrolithotomy (PCNL) is a minimally

invasive procedure. Pain around the nephrostomy tube can be distressing. Skin infiltration of local anesthetic at surgical site is not so effective. So we hypothesize that infiltration of local anesthetic alone or associated with opioid from the renal capsule to the skin along the nephrostomy tract would alleviate the postoperative pain for a long period. Blockade of opioid receptors with peripherally administered opioid is believed to result in analgesia. The aim of this study was to evaluate the hypothesis that combination of local anesthetic and opioid when injected in inflamed tissue can improve the quality of analgesia.^[1,2]

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METHODS

A prospective randomized double-blind controlled study was conducted in 60 ASA physical status I to II adult patients scheduled for PCNL surgery after ethical committee's approval and informed consent were obtained. We selected patients with renal stone size less than 3.0 cm with a single nephrostomy tube (22 F). Patients having supracostal puncture, excessive bleeding, and more than one puncture were excluded from the study. In all patients, balanced general anesthesia was administered using intravenous 2 µg/kg fentanyl as a premedication with vital monitoring. PCNL surgery was performed in the prone position. Patients were randomly assigned to either of the two groups R and RM ($n=30$ patients each) by the closed envelope method. After insertion of the nephrostomy tube, a 23-gauge 90 mm spinal needle was inserted up to renal capsule under ultrasonographic guidance along the nephrostomy tube at 6'O clock and 12'O clock position. In group R, 20 ml of 0.25% ropivacaine plus 0.5 ml distilled water and in group RM, 20 ml of 0.25% ropivacaine plus 0.5 ml of morphine (5.0 mg) were infiltrated (10 ml in each tract) while gradually withdrawing the needle and infiltrating the renal capsule, perinephric fat, muscles, subcutaneous tissue, and skin. The patient was extubated and kept in the post-anesthesia care unit under observation for 24 hours. Post-operative pain was assessed by a blind investigator using a 0-10 point visual analog scale (VAS) at rest and dynamic visual analog scale (DVAS) on deep breathing and coughing where 0 means no pain and 10 means unbearable pain. Pain score was assessed immediately after extubation, half hourly for 2 hours, every two hourly for 6 hours, and every four hourly till 24 hours. When VAS ≥ 4 , intravenous tramadol 1 mg/kg was given as rescue analgesia and the patient was reassessed. Maximum 400 mg of tramadol was given in initial 24 hours. Both groups were compared for duration of analgesia, i.e., time to 1st rescue analgesia, number of doses, and total consumption of tramadol in initial 24 hours. Signs of opioid side effects like drowsiness, nausea, vomiting, and pruritus were noted. Nausea was scored as 0-3 means none to severe. Sedation was scored as 0-3 means fully awake and alert to deep sleep. Injection naloxone was kept ready in case of severe variety of side effects. Post-operatively, all patients had urinary catheter for 24 hours so we could not assess urinary retention.

Statistical Analysis

Statistical analysis was performed using statistical package of social sciences, i.e., SPSS version 12. Continuous data are described as mean \pm SD (standard deviation) and categorical variables are given as no. Continuous variables were compared using the *t*-test for two independent samples. Percentages were compared using Chi-square analysis. A $P < 0.05$ was considered to be statistically significant.

RESULTS

Sixty patients scheduled for PCNL were enrolled in the study. There were no dropouts or exclusions in the study. The demographic data regarding age, sex, weight, and duration of surgery were comparable and non-significant [Table 1]. VAS at rest and DVAS (during coughing and deep breathing) were significantly lower in the ropivacaine and morphine group [Figures 1 and 2]. The mean time for the first demand of analgesia in the RM group was at 13.7 hours and 10.7 hours in the R group ($P=0.0004$) [Table 2]. The mean total consumption of tramadol in the RM group was average 91 mg, while in the ropivacaine group, it was 123.2 mg, which is significantly less ($P=0.0013$) [Table 2]. The mean number of analgesic demands required during initial 24 hours was 1.64 in the RM group and 2.25 in the ropivacaine group ($P=0.0003$) [Table 2]. The side effects like nausea and vomiting were also less in the ropivacaine group than in the RM group but they were not significant. ($P > 0.05$) [Table 3].

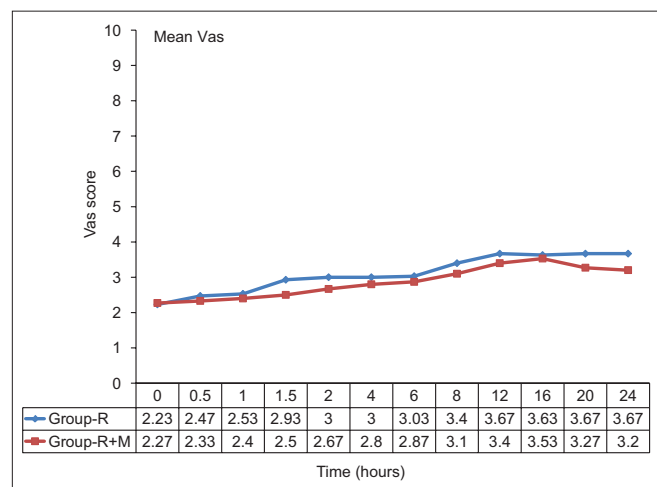


Figure 1: Mean VAS

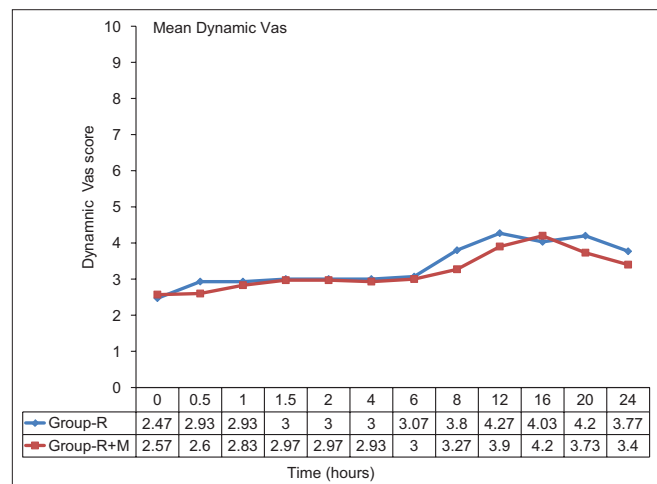


Figure 2: Mean dynamic VAS

Table 1: Demographic data

Parameters	Ropivacaine+morphine (mean [95% CI])	Ropivacaine (mean [95% CI])	P value
Age (years)	38.5 (33.07-44.07)	43.9 (38.5-49.4)	0.158
Sex (Male:Female)	20:10	21:09	0.781
Weight (kg)	54.1 (50.6-57.5)	54.4 (50.9-57.8)	0.899
Duration of surgery (hours)	1.44 (1.23-1.66)	1.45 (1.34-1.56)	0.871

Table 2: Comparison of analgesic requirements

Parameters	Ropivacaine+morphine (mean [95% CI])	Ropivacaine (mean [95% CI])	P value
Mean time for 1 st dose (hours)	13.7 (12.4-15.02)	10.7 (9.72-11.78)	0.0004
No. of doses required in 24 hours	1.64 (1.38-1.9)	2.25 (2.05-2.45)	0.0003
Total consumption in 24 hours	91 (75-107)	123.2 (111.5-134.9)	0.0013

Table 3: Side effects

Side effect	Ropivacaine+morphine (n=30)	Ropivacaine (n=30)	P value
Nausea	2	1	0.301
Vomiting	3	1	0.554
Sedation	1	1	-

DISCUSSION

PCNL is one of the most common endourological procedures at our center. Systemic analgesics like NSAIDs and narcotics have been used for post-operative pain relief but they have their own side effects and limitations especially in patients with potential renal complications.^[3] Local anesthetic infiltration can inhibit inflammatory and local sensitizing responses by directly suppressing some phases of inflammation. Numerous studies have described the efficacy of local anesthetic infiltration in surgical incisions.

From the study by Haleblan *et al.*,^[4] it was hypothesized that the cause of pain after PCNL surgery involving the nephrostomy tube could result from structures beyond the skin puncture site like the renal capsule.

Dalela *et al.*^[5] performed PCNL in 11 patients under a renal capsular block by infiltrating the nephrostomy tract and renal capsule with 2% lignocaine. He emphasized that most of the pain during PCNL is felt at the time of dilatation of renal capsule and parenchyma as it is richly innervated by pain conducting neurons. Araventinos *et al.*^[6] studied the feasibility of doing PCNL in two stages in 24 patients. In the 1st stage, the nephrostomy tube was placed after infiltrating tract site with 2% lignocaine along

the direction of the intended nephrostomy tract. In the 2nd stage, stones were removed after a week under assisted local anesthesia with 2% lignocaine suggesting that all structures especially renal capsule including perinephric fat, muscles, subcutaneous tissues, and skin contribute to the pain and infiltration of these structures by a local anesthetic drug blocks the pain impulses as was seen in our study.

Jonnavithula *et al.*^[7] did the infiltration to the nephrostomy tract in 40 PCNL patients with 0.25% bupivacaine and found lesser pain scores and analgesic requirement in the bupivacaine group than the control group. In our previous study,^[8] we have found out similar results with 0.25% bupivacaine. Gotkten *et al.*^[9] used levobupivacaine infiltration to the nephrostomy tract in combination with intravenous paracetamol for post-operative analgesia and found less requirement of opioid as compared to other groups. Ugras *et al.*^[10] did instillation of skin, nephrostomy tract, and renal puncture site with ropivacaine in 34 PCNL patients. They observed that the VAS at 6 hours, time to 1st analgesic demand, and total analgesic need were significantly lower ($P=0.001$, 0.008, and 0.001 respectively) in the ropivacaine group than the control group.

In our study, for nephrostomy tract infiltration, we used ropivacaine as a local anesthetic and morphine as an opioid along with ropivacaine as it is pure μ receptor agonist with great analgesic potency and long half life. Opioids exert their analgesic effect by acting exclusively in the central nervous system (CNS). However, evidence reveals a peripheral opioid action on receptors without central action raising the possibility of divorcing analgesic action from unwanted central side effects. Many studies on analgesic efficacy of peripheral opioids have been published but the results are conflicting and various mechanisms are proposed for activation of opioid receptors on peripheral neurons.

Mehta *et al.*^[11] performed incisional infiltration of bupivacaine versus bupivacaine with buprenorphine in 40 open donor nephrectomy patients. They concluded that addition of buprenorphine to local anesthetic significantly prolonged the time to 1st rescue analgesic demand and total consumption of rescue analgesic in 24 hours thus providing evidence in support of the existence of peripheral opioid receptors.

Opioids are associated with some side effects particularly with systemic administration like respiratory depression, nausea and vomiting, itching, and urinary retention. In our study, none of the patient had respiratory depression or itching. The side effects like nausea and vomiting and sedation were comparable and mild in both groups. All

patients had post-operative urinary catheter so urinary retention was not observed.

CONCLUSION

Addition of morphine to the local anesthetic, ropivacaine for nephrostomy tract infiltration significantly prolonged the duration of post-operative analgesia and reduced the number of doses and total consumption of rescue analgesic in initial 24 hours in percutaneous nephrolithotomy surgery which favors the existence of peripheral opioid receptors.

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